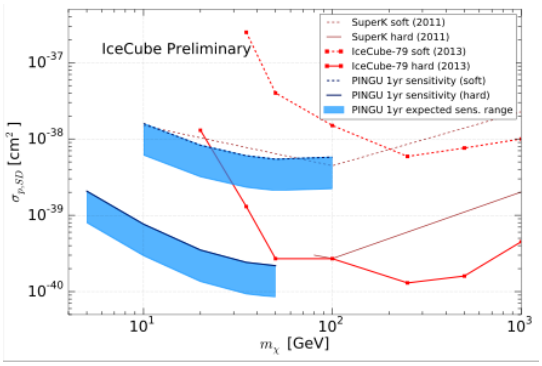
Dear spokesperson,

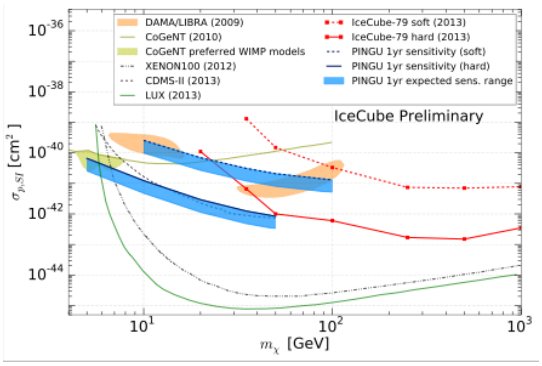
The Workshop on the Intermediate Neutrino Program (WINP) will be held at Brookhaven National Laboratory on February 4–6, 2015. The workshop organizers request that you fill out the enclosed template for describing your experimental plans by January 12, 2015 at 17:00 EST. These templates will be posted on the public WINP website and are intended to facilitate discussion on the best opportunities for neutrino experiments or R&D that can be accomplished in the intermediate time period (~5–10 years) at reasonable cost. Working group convenors may need input from you on an earlier time scale.

Steve Kettell
For the Organizing Committee

1. Name of Experiment/Project/Collaboration: PINGU (part of IceCube-Gen2)
2. Physics Goals
    a. Primary: Neutrino mass hierarchy, indirect WIMP searches.
    b. Secondary: neutrino oscillations, astrophysical sources of low-energy neutrinos, supernova neutrino-burst energy spectrum
3. Expected location of the experiment/project: South Pole NSF research station.
4. Neutrino source: The atmosphere, WIMP gravitational wells, galactic supernova explosions.
5. Primary detector technology: Water (ice) Cherenkov.
6. Short description of the detector: PINGU: 40 additional in-fill strings surrounded by DeepCore strings with roughly 5 GeV neutrino energy threshold and several megaton fiducial volume. (DeepCore: 15 strings at bottom center of IceCube with roughly 10 GeV neutrino energy threshold and ~20 megaton fiducial volume.)
7. List key publications and/or archive entries describing the project/experiment: PINGU LoI (arXiv:1401.2046) and ν(μ) disappearance result (submitted to PRL, arXiv:1410.7227)
8. Collaboration
    a. Institution list (see LoI arXiv:1401.2046 plus new collaborators: Columbia, Drexel, MIT, Michigan State, Queen Mary London)
    b. Number of present collaborators: 317
    c. Number of collaborators needed: Collaboration welcomes new collaborators for building and operating PINGU.
9. R&D
    a. List the topics that will be investigated and that have been completed
    IceCube and IceCube/DeepCore are operating; updating designs of digital optical module (DOM) and drilling systems for IceCube-Gen2 is in progress.
    b. Which of these are crucial to the experiment. The drill and DOM only need to be updated from proven IceCube technologies.
    c. Time line: start 2017 or 18 for a period 4 years.
    d. Benefit to future projects: Testbed for lower energy threshold water Cherenkov experiments.
10. Primary physics goal expected results/sensitivity: see dedicated white paper.
    a. For exclusion limit (such as sterile neutrino search), show 3-sigma and 5-sigma limits: We show the projected PINGU 1-year sensitivities for indirect detection of solar WIMPs.

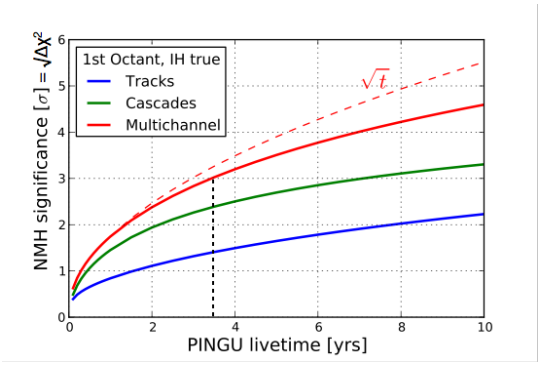


Projected PINGU sensitivity to solar WIMPs with spin-dependent interactions, in the hard and soft channels, compared to other leading results.

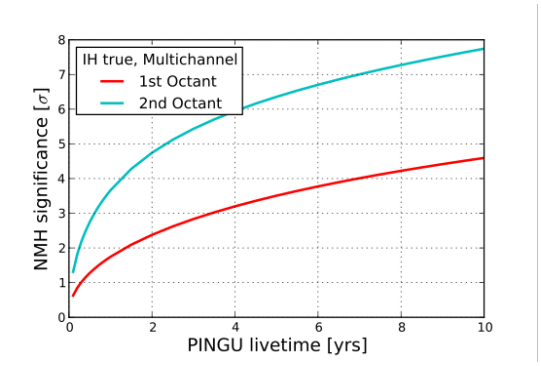


Projected PINGU sensitivity to solar WIMPs with spin-independent interactions, in the hard and soft channels, compared to other leading results.

b. For discovery potential (such as the Mass Hierarchy), show 3-sigma and 5-sigma: We show the PINGU sensitivity to the neutrino mass hierarchy as a function of detector livetime, using fully simulated and reconstructed events, and including the systematic errors listed below in "d." The plot does not include the anticipated year of data that the half-completed PINGU will acquire before full deployment.



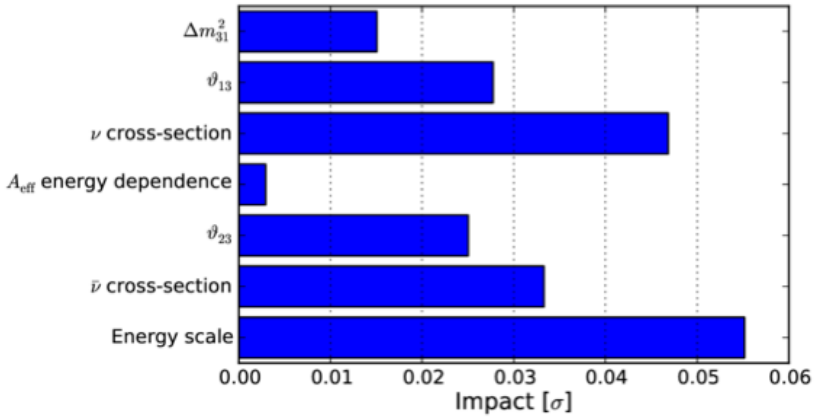
PINGU sensitivity to the mass hierarchy vs. livetime in years, shown separately for cascade-only, track-only and combined channels. The dashed line indicates the sensitivity in the absence of systematic errors. We conservatively assume that the hierarchy is inverted and θ_{23} = 39 degrees.



PINGU sensitivity to the mass hierarchy vs. livetime in years, shown separately for θ_{23} = 39 and 51 degrees (first and second octant), using combined track and cascade channels. We assume that the hierarchy is inverted.

c. For sensitivity plots, show 3-sigma and 5-sigma sensitivities:

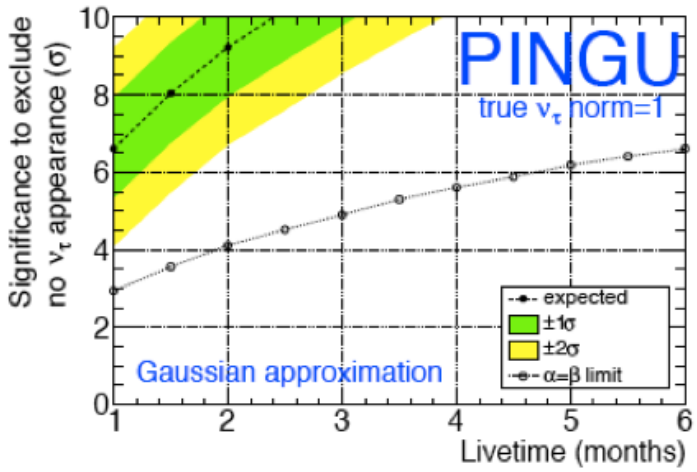
d. List the sources of systematic uncertainties included in the above, their magnitudes and the basis for these estimates:



Chief systematic errors for PINGU measurement of the neutrino mass hierarchy. The "impact" shown is a measure of how much the significance of the measurement improves if the denoted systematic is removed. For more description of each systematic, please see arXiv:1401.2046.

e. List other experiments that have similar physics goals: ORCA, JUNO, RENO-50, numerous accelerator neutrino experiments
f. Synergies with other experiments: NMH significances from reactor & atmospheric neutrino experiments combine better than quadratically (Blennow and Schwetz ref), multiwavelength campaigns with astronomical telescopes

11. Secondary Physics Goal: see PINGU LoI arXiv:1401.2046
    a. Expected results/sensitivity: We show below the DeepCore and PINGU sensitivities to tau neutrino appearance.



The preliminary predicted ability of PINGU to exclude no-ν_τ appearance using atmospheric ν's. No systematics included.

    b. List other experiments that have similar physics goals
12. Experimental requirements
    a. Provide requirements (neutrino source, intensity, running time, location, space,…) for each physics goal: determination of the NMH using atmospheric neutrino flux within 3-4 years (median expectation). Installation at South Pole station requires 2-3 austral summers with appropriate levels of logistical support.
13. Expected Experiment/Project time line
    a. Design and development: now-2016
    b. Construction and Installation: 2017-21
    c. First data: data taken uninterrupted as IceCube grows into IceCube-Gen2
    d. End of data taking: Primary result requires several years of data, secondary results benefit from more data, ultimately will run for as long as IceCube-Gen2 to search for astrophysical sources.
    e. Final results: For neutrino mass hierarchy we expect to reach 3σ in early 2024
14. Estimated cost range
    a. US contribution to the experiment/project: It is the goal to obtain a substantial fraction, more than 50% in certain instrument subsystems, from non-US funding sources. Examples are the optical sensor modules (total ~$15-20M), data acquisition and other subsystems.
    b. International contribution to the experiment/project (see above)
    c. Operations cost: As the experiment is frozen in ice and all data acquisition is digital, integration with IceCube is possible at a very low level with minimal impact on operations. Additional PINGU instrumentation will require approx. 10 kW; Moore's Law and ongoing data reduction development should lead to minimal increases in required computational and data archive investments. Total IceCube-Gen2 operations costs similar to IceCube are envisaged ($7M/year).
15. The Future
    a. Possible detector upgrades and their motivation: Further increase in photocathode density in the ice might make possible "MICA," a multi-megaton Cherenkov ring-imaging detector with a GeV scale energy threshold. MICA would have sensitivity to proton decay and supernova neutrino bursts in other galaxies.
    b. Potential avenues this project could open up